

***FAST MEASUREMENTS OF ATMOSPHERIC AEROSOL SIZE DISTRIBUTIONS
USING A FAST INTEGRATED MOBILITY SPECTROMETER IN AIRCRAFT***

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ABSTRACT

Measurements of aerosol size distributions with a time resolution of 1 Hz were carried out using a recently developed Fast Integrated Mobility Spectrometer (FIMS). The FIMS is capable of measuring sub-micrometer aerosol size distributions with high time resolution, size resolution, and counting statistics. These attributes make the FIMS an ideal instrument both for aircraft-based measurements and for studies of rapidly changing aerosol populations.

The FIMS consists of a classifier, condenser, and detector. Inside the classifier, under the influence of an electric field, charged particles are separated into different flow streams based on their electrical mobility. The classified particles are then carried by a butanol-saturated sheath flow into the condenser, where a supersaturation of butanol is generated through electrical cooling and the classified particles grow into super-micrometer droplets. At the exit of the condenser, a laser sheet illuminates the grown droplets, and their images are captured by a high-speed CCD camera. The images provide not only the particle concentration, but also the particle position, which directly relates to the particle electrical mobility. By simultaneously measuring particles of different sizes/mobilities, the FIMS can provide full size spectrums of submicron aerosol at a time resolution of 1 Hz, nearly 100 times faster than traditional SMPS systems. Since the individual particle and its position are detected optically using the high resolution CCD camera, the FIMS also offers high size resolution and counting statistics.

The performance of the FIMS, including its time resolution and sizing accuracy, was characterized under a variety of conditions using both atmospheric aerosols and laboratory-generated aerosols. The FIMS was recently deployed in a research aircraft in the Cumulus Humilis Aerosol Processing Study (CHAPS 2007). Comparisons are made between atmospheric size distributions measured by the FIMS and a customized SMPS for data from the CHAPS program.

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